

# INBETWEEN

# E-PUBLICATION

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# **PROJECT CONSORTIUM**

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## **TIMELINE**

**Start date: 01/11/2017**

**End date: 31/10/2020**



# PROJECT CHALLENGE

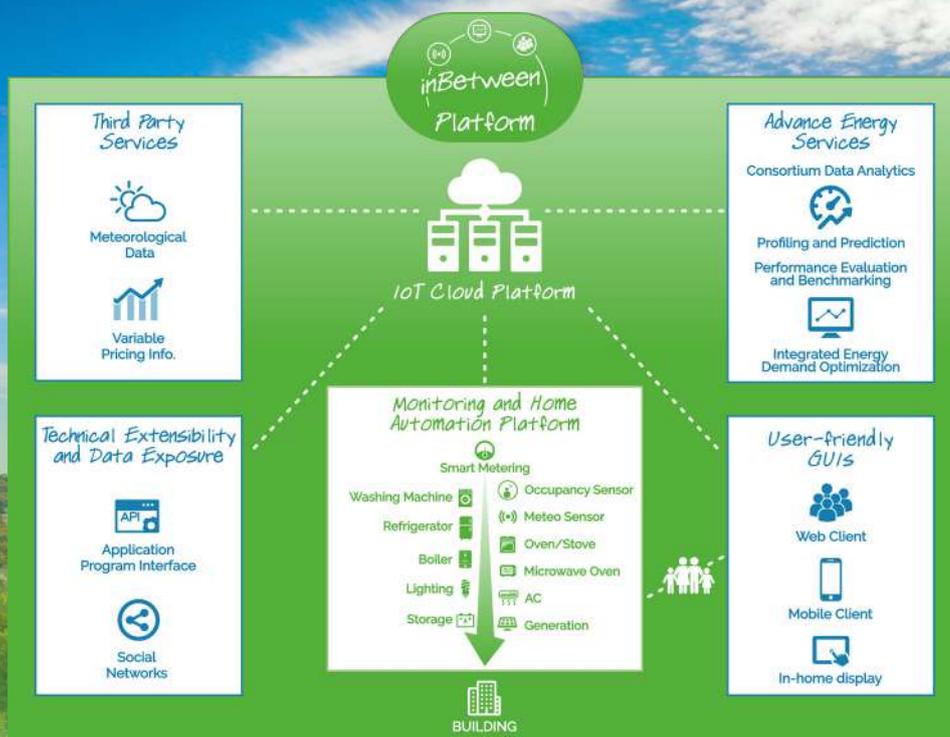
*Nowadays, inducing a behavioral change towards energy efficiency represents an unmet societal challenge with potentially enormous environmental impact.*

*In fact, buildings account for 40% of the total EU energy demand and a change in the residents' behaviour can reduce energy consumption ranging from 5% to 20%, but it is still difficult to get people to adopt a more energy-efficient lifestyle due to several factors:*

- low monetary benefits for the individuals (in most cases, potential savings on an average energy bill does not represent a significant portion of the home budget)*
- low capability to change energy demand patterns and energy use practices due to aspects related to lifestyle, habits, daily routines, work/family commitments*
- lack of global conscience related to the impact of energy generation and use on the environment (pollution, Greenhouse Gas emissions) , and the tendency to perceive the individual consumption as insignificant*
- the complexity of existing ICT platforms/tools which usually require intensive User engagement often interfering with the normal, everyday, activities.*

*InBetween went beyond the currently available ICT technologies used for inducing the End User behaviour change towards more energy efficient lifestyles by simultaneously assisting users to IDENTIFY energy wastes, LEARN how they can conserve energy and MOTIVATE them to act.*

*InBetween project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 768776.*



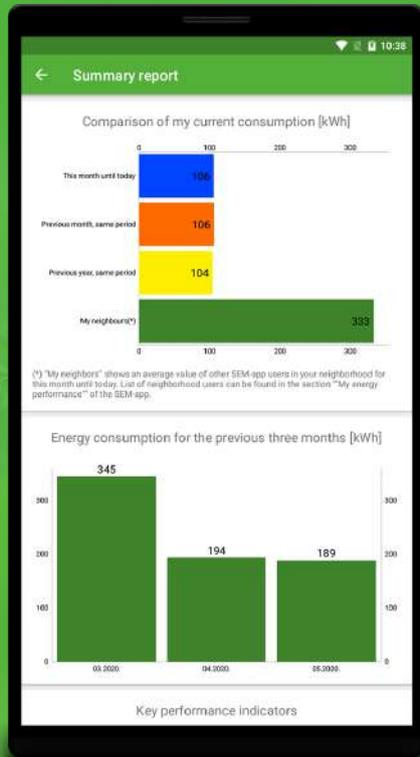
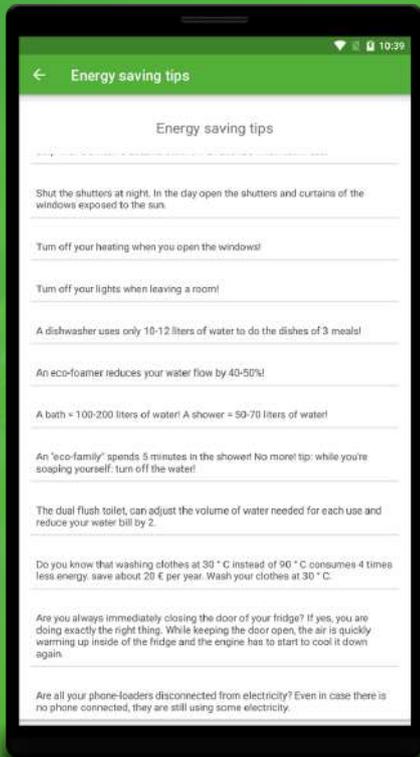
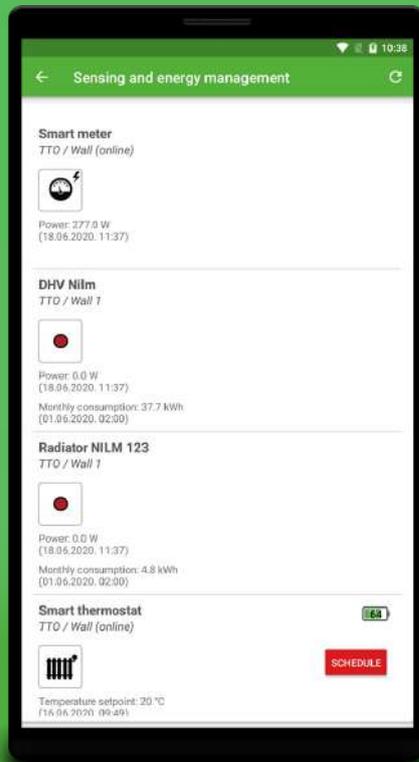
# INBETWEEN INNOVATIVE CLOUD-BASED PLATFORM

The ultimate aim of the project is the development of a SET OF SMART SOLUTIONS for buildings and, in particular, to develop a WEB INTERFACE and a MOBILE APPLICATION, two interfaces for the same InBetween platform.

The INBETWEEN Platform offers advanced energy services, such as:

- An **energy performance evaluation and benchmarking service** which take into account three main energy analytics (current consumption, occupancy, weather conditions) and uses social comparison and information as a driver to promote energy-efficiency behaviours
- An **Energy dispatch optimization service** which monitors users' energy consumption, determines the optimal time in which an appliance in a specific home should be activated in order to minimize costs and optimizes any potential presence of renewable energy sources like solar panels or wind turbines. The **"remote control" feature**, accessible through the interface of the mobile application, is another key ingredient of this service allowing user to control their devices even when they are not at home. Finally, this service also monitors the total energy consumption, estimated CO<sub>2</sub> emissions and share of renewable energy for the initial and optimized schedule of appliance activations and presents to the end users the potential savings that can be achieved using the optimization service
- A **Non-Intrusive Load Monitoring service**, which provides feedback to household residents on the way they spend their energy and, more precisely, on which home appliances are in use by connecting smart meters (e.g. sensors for measuring the energy consumed) with every appliance at home.
- A **Real Time Home Monitoring Service**, which runs without stopping 24/7 and in close-to-real-time analyzes events that pertain to energy conservation, security and health-related issues, and fires notification through the mobile application which are meant to motivate the end user to adopt more energy-efficient, safe & healthy behaviors.

To sum up, the InBetween platform (through their web and mobile versions) connects building's systems with advanced energy analytics and optimization services to create a comprehensive and customized set of recommendation and feed-back for their users.



# INBETWEEN KEY FINDINGS

*One of the biggest success of the project is to have been able to figure out the best way to engage the users and to develop a service tailored to their needs. Throughout the process of developing, designing and testing the platform, the Project Team has been working closely with the users and the demonstration site of demo-sites Managers to investigate the various barriers and opportunities for users' engagement and for saving energy. The result is a user-centric platform designed in a way that the Users can tailor the services to their own needs and according to their preferences without compromising their comfort.*

*The InBetween platform is available in two versions to reach the different type of "digital users": a mobile application and a web browsers application. They were both designed to tackle barriers related to users agency (e.g. low motivation to save energy, lack of knowledge how to save energy) and capacity (difficulty or inability to act in order to save energy). Different kind of services, such as the schedule services, the timely notifications, and the benchmarking provide mix of socio-economic and environmental motivations to save energy. The actuators and the notifications help making energy saving easy and, at times, seamless.*

*Example. Via the different actuators the Users can select which appliance to switch on/off remotely and can schedule the operation of the appliances along the week according to what suits them most. The platform provides Users the information about the most efficient option for scheduling, which Users can either accept or reject. In addition, the platform sends timely and tailored notifications which enable users to act in order to save energy (e.g., close window then the heating is on, turn off heater when indoor temperature is high), improve health condition (e.g., open window when air quality is declining) , or improve the security of their homes.*

*This was not an easy path though. Several difficulties have been encountered, since people's habits are not easy to change. For instance, we have found that people who were already interested in energy savings were not keen on using ICT tools to support them, as they didn't see the added value compared to their daily practices. On the other hand, people who were not initially interested in energy efficiency were difficult to bring into the project, as they didn't see energy as a priority in their daily life.*

*Another important result was achieved for the energy consumption forecasting, one of the energy services provided by the platform, through the clustering method. Aggregating similar consumption data from selected buildings for the selected period make it easier to visually compare time periods and draw conclusions. Additionally, it allows to identify suspicious patterns of consumption. With the help of clustering we could compare similar energy consumption patterns and use the result for improving the InBetween forecasting service.*

*The clustering approach has been also adopted to analyse the Covid-19 lockdown restrictions and the consequent change in permanence in the buildings, as well as the behaviour of residents before and during the restrictions, and the results are on the way.*





# INBETWEEN BENEFITS FOR THE EU COMMUNITY

*The InBetween platform delivers multiple benefits - economic, security, health and environmental - without compromising on users' comfort:*

- 1. It improves users' convenience and comfort: the actuators and scheduling services allow users to easily and seamlessly operate their appliances, even when they are away from home.*
- 2. It helps users save money: the energy saving advice, notifications, actuators and scheduling services help users to save energy without compromising comfort, and accordingly, save money.*
- 3. It helps improving users' health: the air quality monitoring and notifications allow users to be aware of their indoor air quality and open window when quality deteriorate.*
- 4. It improves users' security: the sensors on windows and notifications allow users to be aware of cases in which the house is not populated and a window is open.*
- 5. It helps reduce carbon emissions: the energy saving leads to carbon emission reductions.*



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